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(54) Abstract Title
Data communications connectors

(57) The contacts of an RJ 45 jack are modified by addition of a mechanical link 50 at their free ends. The link ensures substantially uniform deformation of the contacts on insertion of a plug whereby electrical connection between plug and jack is only established if the number of contacts on each is the same. The bar may carry a capacitive array to correct for crosstalk and may be a PCB or thermoplastic moulding enclosing extensions or modifications to the contacts which provide the capacitance. The bar may be arranged behind the rear wall of the jack.

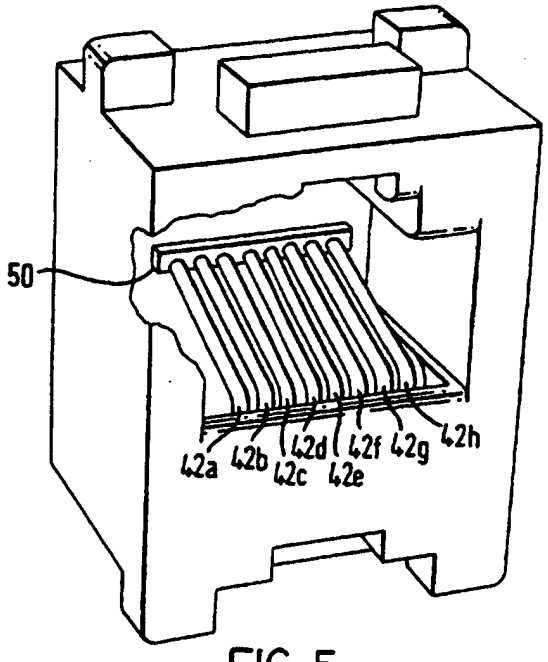

FIG. 5

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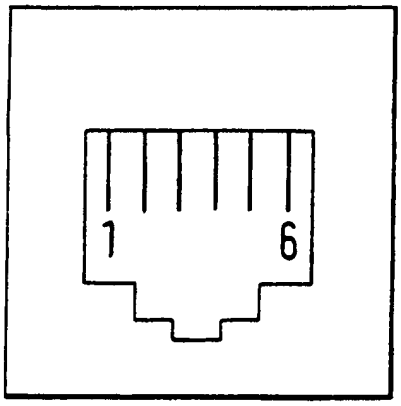

FIG. 1
(PRIOR ART)

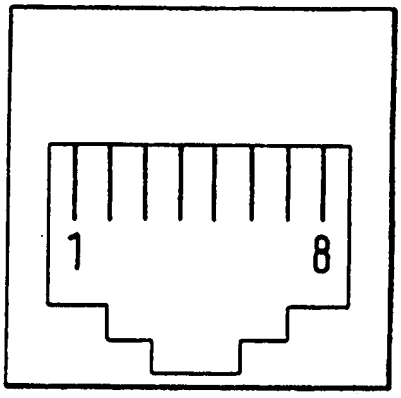

FIG. 2
(PRIOR ART)

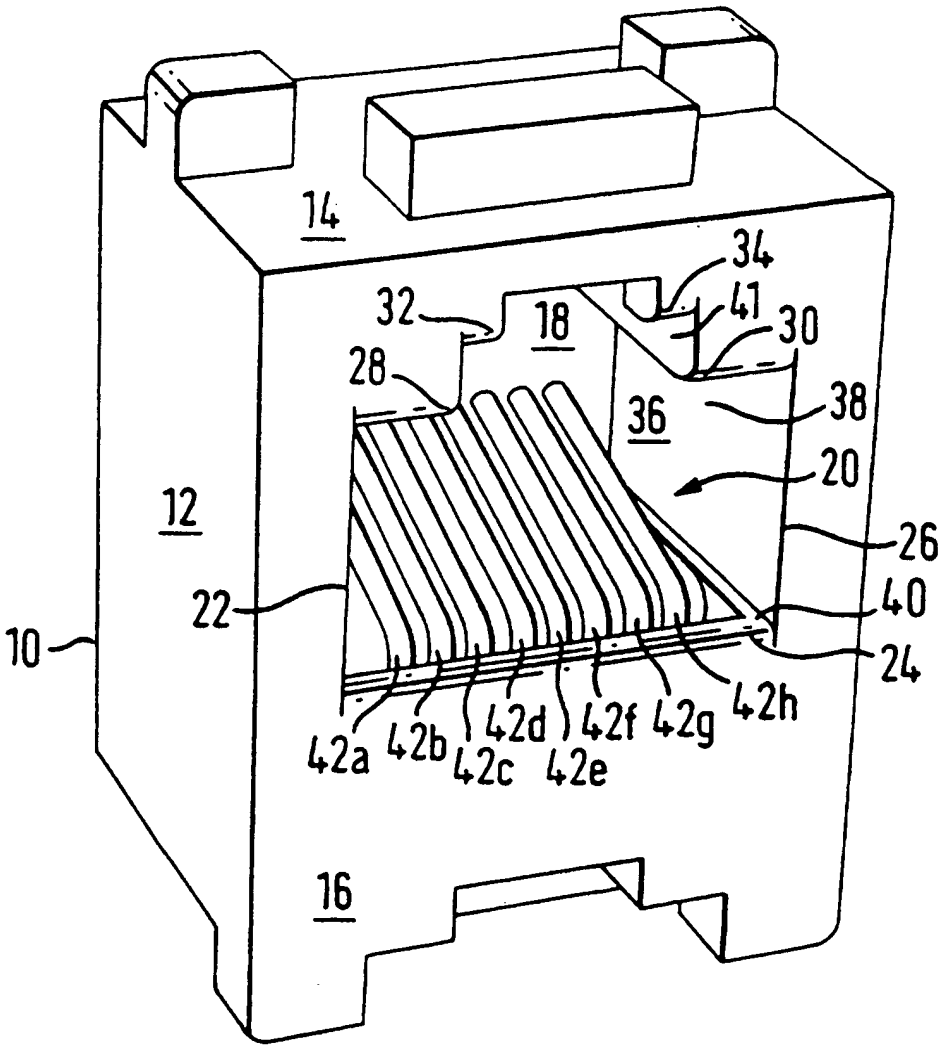

FIG. 3
(PRIOR ART)

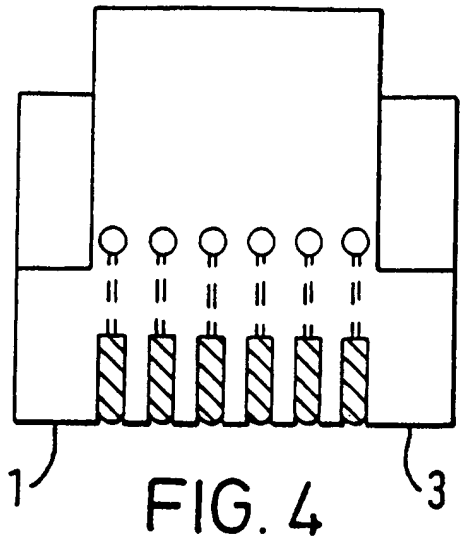

FIG. 4

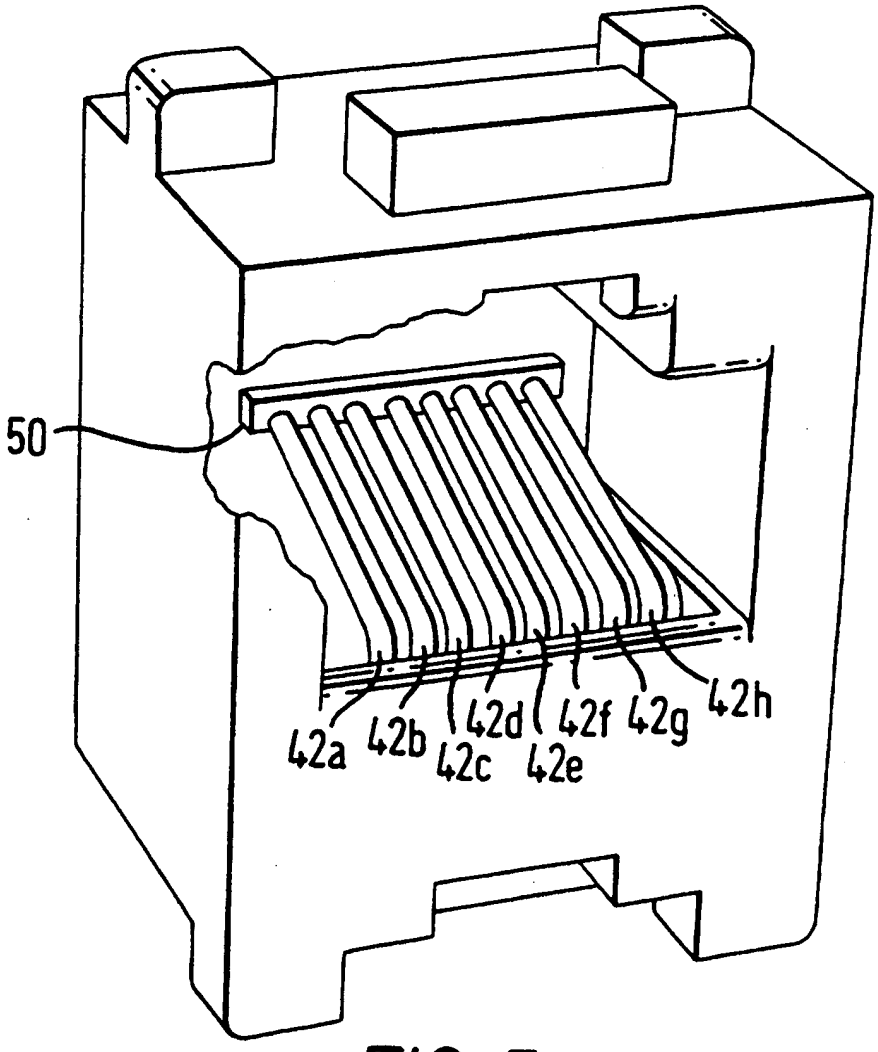

FIG. 5

Data Communications Connectors

This invention relates to connectors for data communications applications. More particularly it relates to modular telephone connectors used for telecommunications applications and to the reduction of crosstalk in such connectors.

In the telecommunications field, the RJ ("Registered Jack") style of connector has become the de facto World Standard. The Modular Jacks and plugs referred to as RJ type connectors are described as part of 47 CFR 68.500 et seq in the USA.

RJ connectors were first introduced for use, principally, in telephone systems. However, the connectors have found universal acceptance whenever a simple communications connector is required. They are presently used extensively for data communications within computer networks.

47 CFR 68.500 describes a series of connectors having two, four, six or eight contacts. The eight contact connector is generally referred to as the RJ 45 style and the four and six contacts are referred to as RJ 11 and RJ 12 respectively. The jacks will always accept insertion not only of the plug for which they are intended, but also of a plug with a smaller number of contacts. Thus, an RJ 45 jack can accept an RJ 11 or RJ 12 plug and an RJ 12 jack can accept an RJ 11 plug. For a telephone network having standardised wiring this is desirable; it allows a telephone equipped with, e.g. a four-contact plug to mate satisfactorily and function on a telephone line which has been terminated with a six or eight contact jack. This ability is a design feature of the connector system.

The four or six contact plug and jack has become standard for telephone systems, whereas the eight contact plug and jack has become standard for computer networks although it still finds some use in telephone systems. Whilst the inter-operability of jacks and plugs having different numbers of contacts is useful for telephone systems, it is not desirable to be able to connect successfully a telephone to a jack intended for connection to a computer. Because of this, particular attention is paid to the wiring standards, or sequences, used in the computer application as there is always a possibility that a telephone will be connected to a wall mounted jack which is intended for a telephone. If this were not possible, then a more convenient, higher performance, wiring sequence could be adopted for computer applications.

Many other connector styles have been proposed. However they have all failed to gain acceptance either through being relatively expensive or difficult to use. There is a great reluctance in the data communications industry to move away from the RJ 45 connector style in view of its extreme versatility and its cost effective design.

A first aspect of the invention aims to overcome the problems discussed above.

A further problem which arises from the use in high speed data communications of RJ type and other connectors originally designed for telephone systems is crosstalk. Crosstalk is a signal induced from one active circuit into the conductors of another active circuit. In data systems, crosstalk signals can be erroneously recognised as valid data and cause corruption or malfunctions of systems. The problem of crosstalk is well known and well

documented and there have been many proposals for crosstalk correction in data communications circuits.

Where connectors are installed in the infrastructure of a building wiring system, jacks will be equipped with a second connector interface, usually insulation displacement contacts (IDCs) to allow their connection to the wiring installed within the building. A number of methods have been proposed for correcting crosstalk which occurs between the jack and its associated IDCs. Examples are disclosed in US 5,229,956 (Brownell), and US 5,186,647 (Denkmann). These always consist of the addition of some means of correction, usually capacitance, between the jack and its IDC connector.

We have appreciated that it is most desirable for crosstalk correcting capacitance to be located as close to the jack as possible, even within the jack, and a second aspect of the invention aims to provide a new means of correcting crosstalk in modular connectors.

The invention is realised by providing a mechanical link between the jack contacts to ensure substantially uniform depression or deformation on insertion of a plug. More specifically, there is provided a telecommunications jack having a body defining a chamber for receiving a plug, a plurality of resilient contacts arranged in the chamber to establish electrical connection with contacts on a plug inserted into the chamber, and a mechanical link means linking the resilient contacts, whereby on insertion of a plug, the plurality of contacts are depressed by a substantially uniform amount.

The advantage of the mechanical link is that it ensures uniform depression or deformation of the contacts on insertion of a plug. An RJ 11 or RJ 12 standard plug will normally deform the outer contacts of an RJ 45 jack

by a greater amount than the inner contacts which establish electrical contact. An embodiment of the invention ensures that all the contacts are deformed by the same amount so that where an RJ 11 or 12 plug is used with an RJ 45 jack embodying the invention, the plug can be engaged but no electrical contact made as the inner contacts of the jack have been deformed too far. Thus, a six or four contact telephone plug cannot be connected to an eight contact computer jack accidentally.

As a result, data communications systems including jacks embodying the invention can adopt more desirable and more effective wiring sequences.

The link means may be a bar arranged behind the rear of the jack or in the chamber if their is sufficient room.

In a preferred embodiment of the invention the link means carries or encloses a capacitive array. This has the advantage of correcting for crosstalk at the point at which it occurs. Not only is this more accurate than prior art arrangements, but it also reduces greatly the amount of additional capacitance required.

In a preferred embodiment the link is a printed circuit board (PCB) have a capacitive array mounted thereon. In another preferred embodiment the capacitance is obtained by extending or modifying the form of the contacts. Preferably these modified or extended contacts are retained within the link means. Preferably in that embodiment, the link means is a thermoplastic moulding.

Embodiments of the invention, in its various aspects, will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 is a schematic view of an RJ 11 and RJ 12 interface;

Figure 2 is a schematic view of an RJ 45 interface;

Figure 3 is a perspective view of a prior art RJ 45 jack;

Figure 4 is an end view of an RJ12 style plug; and

Figure 5 is a perspective view, partially cut away, of an RJ 45 jack embodying the invention.

Figure 1 shows an RJ 11 or RJ 12 connector, sometimes referred to as a WE4W/WE6W. The connectors are identical in dimension but the RJ 11 has the outermost two contacts (1 and 6) removed. The modular plug has a centre locking tab with a shoulder to hold it into the jack. An end view of the plug is shown in figure 4. The six contacts on the plug are received in slots and it will be seen that there aer walls 1,3 where the seventh and eigth contacts would be on an eight contact RJ 45 plug. Figure 2 shows, schematically, the RJ 45 or WE8W style. The plug is wider so that an RJ 45 plug cannot mate with an RJ 11/12 jack. However, an RJ 11/12 plug will mate with an RJ 45 jack in which case pin 1 on the RJ 12 plug will connect to pin 2 of the RJ 45 socket, pin 2 to pin 3 etc. Pins 1 and 8 of the RJ 45 remain unconnected and, in the case of the RJ 11 plug, pins 1,2,7 and 8 remain unconnected.

Figure 3 shows an RJ 45 jack in perspective. It comprises a main body 10 having side walls 12, top and bottom walls 14, a front wall 16 and a rear wall 18. The front wall 16 has an aperture 20 having a shape similar to that of the RJ 45 plug it is intended to receive. Thus, as also shown in Figure 2, it is a symmetrical aperture having three rectilinear sides 22,24 and 26 and on the fourth side a pair of shoulders 28,30 and a further pair of shoulders 32,34 which combine to form a channel to receive a corresponding key on the plug to retain the plug

in position on the jack. As the aperture is symmetrical about its longitudinal central axis Y-Y, and as RJ 11/12 plugs have the same key, RJ 11/12 plugs will be received in the RJ 45 jack. It will be understood from an appreciation of figure 4 that on insertion of an RJ 12 plug into an RJ 45 socket the side walls 1,3 of the plug will depress the outermost contacts on the RJ 45 plug to a postion beneath the normal position to which they are depressed when an RJ 45 plug is inserted.

The aperture 20 permits access to a chamber 36 which is bounded by side walls 38, a bottom wall 40 and a series of upper walls 41 which follow the shape of the fourth side. The rear wall of the chamber is the rear wall 18 of the jack. A series of eight wire contacts 42 a-h is located in the chamber, entering the chamber at the front of bottom wall 40 and extending upwards into the chamber. The contacts 42 end towards the rear of the chamber but extend through the front of the bottom wall and out through the rear of the connector for termination, for example, to an insulation displacement connector. The wire ends in the chamber are resilient; when a plug us inserted into the chamber, the plug body will force the wires down against their natural resilience and contacts on the underside of the plug will make contact with respective ones of the wire contacts 42 a-h. Although not shown in the drawing the rear wall of the plug has a series of parallel slots to receive and guide the contacts, maintaining them parallel during movement produced by insertion of the plug, and keeping them apart when no plug is inserted.

Where an eight contact plug is used, each of the wire contacts 42 will make an electrical connection. However, where a 4 or 6 contact plug is used, the four or two

outermost wire contacts 42 a,b,g,h or 42 a,h will not make contact. The geometry of the standard RJ style plug is such that the outer, non functioning wire contacts are deflected by the plug to a position well below their normal connecting position. The unused contacts are depressed by approximately 0.5 mm more than they would be if depressed by plug contacts, say on an RJ 45 plug, and not by the plug body.

Turning now to Figure 5, the embodiment of the invention illustrated aims to ensure that all the wire contacts 42 a-h are depressed by the same amount no matter how many contacts there are on the plug being inserted. Thus, whether the plug has four, six or eight contacts, all eight contacts of the jack will be depressed by the same amount. This is achieved by linking the wire contacts 42 a-h together using a mechanical link, preferably a rigid link. Thus, if a four or six contact plug is inserted, causing the outer four or two contacts to be depressed further than their normal contact position, the link will ensure that all eight contacts 42 a-h are depressed by the same amount and to a point below which they can successfully make electrical contact with contacts on the plug. Thus, although a four or six contact plug can be received in the jack it cannot make electrical contact between the plug and jack circuits. This means that it is not possible to connect a telephone appliance having a six or four contact plug to a data communications outlet having an eight wire jack embodying the invention. As a consequence it is no longer necessary to adopt a wiring sequence in the jack that is designed specifically to avoid problems when the wrong plug is inserted. For example wiring sequences may concentrate on the outer contacts which would not be effected by

insertion of an RJ 11/12 plug. Instead, the preferred wiring sequence can be shown for the particular data application.

In Figure 5 the link is shown as a mechanical link bar 50 which has eight equally spaced holes each of which receives one of the wire contacts 42 a-h. The link is shown as rectangular although it could be any convenient shape. The link 50 is made of a suitable non- conductive material preferably a thermoplastic material.

The view of Figure 5 is partially cut away with the rear wall of the chamber required. Preferably the link bar is located behind the rear wall and the contacts extend through that wall. It will be appreciated that such contacts are longer than standard contacts. The bar may be located in the chamber provided that there is sufficient space for the plug to be received and fully engaged. Where the bar is located behind the rear wall, the wires 42 pass through the elongate slots as in the prior art example described previously. However, as the primary function of the slots in the prior art is to keep the wires spaced and to ensure parallel movement on plug insertion, it will be appreciated that these slots are no longer essential as the link bar performs both these functions. As an alternative the rear wall may, in part, be omitted, providing, effectively, a single large aperture at the rear of the jack through which all of the wires pass.

Thus, the embodiment of Figure 2 provides a mechanical, non-conductive link means between the jack wires to cause them to move uniformly on insertion of a plug. In practice a limited degree of flexibility is required to ensure that all the contacts can make satisfactory connection in normal use since each may have

a very small difference in position relative to its neighbour. Whilst this is best achieved by careful design of the contact geometry it may also be achieved by suitable design of the linking bar.

The principle of the linking bar may also be used to correct for crosstalk between the contact wires 42 a-h. It is well known that a suitable array of capacitances provides crosstalk correction and that these capacitances may be provided on a printed circuit board (PCB). In a further embodiment of the invention, the non-conducting mechanical link is replaced by a PCB having a suitable array of capacitors arranged on it.

It will be appreciated that the PCB may also perform the function of the link described previously.

Alternatively the capacitor array can be provided by extending or modifying the contact form within a thermoplastic moulding, or other convenient material link attached to the contacts in the manner shown in Figure 5.

The methods of crosstalk correction described have the advantage that the crosstalk correction is applied exactly where the crosstalk occurs at the jack contacts. This is in distinction to the prior art methods which correct further along the conductive paths of the circuit. As a result, the embodiment described can correct more accurately and with a significant reduction in the amount of additional capacitance required.

Claims

1. A telecommunications jack having a body defining a chamber for receiving a plug, a plurality of resilient contacts arranged in the chamber to establish electrical connection with contacts on a plug inserted into the chamber, and a mechanical link means linking the resilient contacts, whereby on insertion of a plug into the chamber, the plurality of resilient contacts are depressed a substantially uniform amount by the plug.

2. A telecommunications jack according to claim 1, wherein the link means is a bar.

3. A telecommunications jack according to claim 2, wherein the bar is arranged behind a rear wall of the jack body, and the rear wall comprises at least one aperture through which the plurality of resilient contacts pass.

4. A telecommunications jack according to claim 2, wherein the bar is arranged in the chamber.

5. A telecommunications jack according to any of claims 1 to 4, wherein the link means is rigid.

6. A telecommunications jack according to any preceding claim wherein the link means is arranged at free ends of the contacts.

7. A telecommunications jack according to any preceding claim wherein the link means is made of a non-conducting material.

8. A telecommunications jack according to claim 7, wherein the link means is a thermoplastic moulding.

9. A telecommunications jack according to claims 7 or 8, wherein the link means includes a capacitive array.

10. A telecommunications jack according to claim 9, wherein the plurality of resilient contacts are elongate wire contacts and said link means is arranged at an end of the wire contacts, wherein the capacitive array comprises extensions or modifications to the contacts arranged in or on the link means.

11. A telecommunications jack according to claim 10 appendent claim 8, wherein the extensions or modifications to the contacts are within the thermoplastic moulding.

12. A telecommunications jack according to any of claims 1, 6 or 7, wherein the link means is a printed circuit board (PCB).

13. A telecommunications jack according to claim 12, wherein the PCB carries an capacitive array.

14. A telecommunications jack according to claim 12 or 13, wherein the PCB is arranged behind the rear wall of the jack and said plurality of contacts extend through at least one aperture in the rear wall of the jack.

15. A telecommunications jack according to any preceding claim, wherein the jack is an RJ style jack.

16. A telecommunications jack according to claim 15 wherein the jack is an RJ 45 jack.

17. A telecommunications jack, substantially as herein described with reference to Figure 5 of the accompanying drawings.

Application No:	GB 9704160.2	**Examiner:**	Mrs Jennifer Bannister
Claims searched:	ALL	**Date of search:**	17 April 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

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Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2206248 A	[KEPTEL INC] see link 50 figures 8-11	1, 2, 5, 7, 15
X	US 5118312	[LU] see link [jack plate] 22	1, 2, 5, 6, 7, 15

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